Measuring Bone Mass among Uninsured Hispanic Women with Quantitative Ultrasound

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ABSTRACT

Osteoporosis is an acceleration of bone resorption that produces a lower total bone mass and density in the trabecular bone, being most common in older women. Bone mass is determined largely by genetic factors, as well as physical activity, diet, and hormonal status. The primary way to assess the potential for fragility fractures has always been to have a dual energy x-ray absorptiometry (DEXA) scan of the body. This is still an acceptable diagnostic measure, but not all populations can afford this. Some Hispanic women are at a disadvantage due to their low socioeconomic status and lack of resources. Little research exists to examine the bone health of this specific age or ethnic group of women. The purpose of this study was to determine the feasibility of conducting quantitative ultrasound (QUS) screening of uninsured Hispanic women to determine low bone mass in the calcaneus. The population included in the study was a convenience sample (n=69) of women who attended a free health clinic. Upon consent, participants placed their foot on the Achilles Bone Ultrasonometer to have their bone mass evaluated with ultrasound. A series of 2 to 3 measurements were taken for each patient to ensure reproducibility. The average of the measurements was used for estimation of Stiffness Index (SI) and bone mineral density (BMD). The mean calcaneal SI and BMD Z-score (BMDz) for all 69 participants was 99.3 (SD 14.2) and 0.11 (0.87 SD), respectively. There was a strong, direct relationship between BMDz and SI values, which made for a stronger dependent variable to gauge bone mass in the calcaneus. Implications: This feasibility study was designed to establish that QUS is a feasible means for determining the bone mass in a sample of uninsured Hispanic women that attend a free clinic. This research represents the early development of a model of

prediction for a sample of this population. With continued research and more rigorous studies, QUS may be established as an everyday practice to screen underprivileged populations for osteoporosis.

Dedicated to John and Karyn Reddaway, for always believing in me.

AKNOWLEDGEMENTS

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CHAPTER 1

1.1 PROBLEM STATEMENT

Uninsured Hispanic women may be at risk of not achieving peak bone mass due to their lack of resources. Hispanic women have a higher rate of poverty than white women, as 32% of Hispanic females have an annual income for a family of four of less than $20,650.00[1]. With a third of Hispanic women living on the edge of poverty, this results in a disparity in dietary and health care options. Census statistics indicate that Columbus, Ohio's Hispanic population has increased significantly with this migration representing 3.55% of the total population of the city[2].

Peak bone mass is determined largely by genetic factors as well as physical activity, diet, and hormonal status. The maximum bone density is typically reached during the third decade of life[3] (Figure 1). After this point in development, the rate of resorption increases over formation of new bone. The rate of bone loss averages about 0.07% per year and the most susceptible part of the skeleton is the trabecular rich bone[3] (Figure 1). Sites that are rich in trabecular bone are the spine, femur, and heel. Osteoporosis is an acceleration of this resorption process that produces a lower total bone mass and density in the trabecular bone. It is conceivable that as this population ages, there will be an appreciable increased incidence of osteoporosis among these postmenopausal women.

1.2 REVIEW OF LITERATURE

There are a number of known risk factors for developing low bone mass. Some of these characteristics and behaviors include advanced age, cigarette smoking, low body weight, inadequate calcium intake, and white ethnicity. The evaluation of risk factors alone has been insufficient to accurately diagnose low bone mass. It has also been too insufficient to predict fracture risk in individual patients[4]. As far as fracture risk prediction is concerned, there is abundant research available on the imaging techniques to make this diagnosis. At the forefront of predicting fractures related to osteoporosis is broadband ultrasound attenuation (BUA). The published research that is available is centered on predicting fragility fractures (fractures that occur from standing height or less in an otherwise healthy adult that reflect poor bone quality) among Caucasian postmenopausal women.

Prior to the use of BUA, dual energy x-ray absorptiometry (DEXA) was the primary way to assess the potential for fragility fractures. A 1998 study was conducted to compare the effectiveness of DEXA compared to BUA to determine low bone mass within the calcaneus of postmenopausal women. The BUA measurements were made of the calcaneus using a GE/Lunar Achilles ultrasound system. In this study, improved correlations, from $r = 0.72$ to $r = 0.86$, were found between BUA and DEXA to determine bone density (BMD) values. When assessing actual bone mass and strength, the conclusion was that ultrasound may provide structural information independent of the BMD. It was suspected that the calcaneus would be dependent on height and weight and therefore biased in its ability to predict the risk of fracture, since it is a weight bearing bone. However, the results of this study showed that other skeletal sites, such as the femoral neck and lumbar spine, were dependent on body weight. BUA measurements were strongly correlated with femoral neck, spine, and calcaneus DEXA data, while there was a higher correlation between BUA and DEXA data at the calcaneus, more than other axial skeletal sites[5].

A similar case-control study was performed, using in vitro calcaneus bones rather than in vivo. The purpose of the study was to provide new information on the use of quantitative ultrasound (QUS) for predicting fracture risk and testing QUS against DEXA. Quantitative ultrasound measures how the ultrasound beam changes as it passes through the calcaneus. It also examines the structure, elasticity, and strength of the bones while measuring the speed of sound and broadband attenuation. Testing was successfully completed with only 30 bone specimens. QUS measurements in vitro were strongly correlated with DEXA and trabecular bone density. QUS and DEXA were positively associated with calcaneus bone strength. This study also found that QUS of the heel could provide additional information beyond what is provided by DEXA measurements. While the study demonstrated strong relationships between QUS of the heel and fragility fractures, additional studies need to be conducted in vivo to confirm these findings[6].

An additional 2001, case-control study was conducted using QUS to evaluate boney architecture and density of the calcaneus. As with the previous study, human cadaver calcaneus bones were used, but in this replication, an N of 69 was used. The results of the study indicated that QUS did assess trabecular architecture as well as bone density, but only to a limited extent. With QUS, most of its variability could not be explained by density alone. This study found that, for the first time, that architectural variables could predict more of the variation in measurements with QUS. Bone density may be independent of the trabecular architecture that exists within the bone. QUS may be better at predicting bone architecture due to trabecular bone than the bone density alone. These researchers advocated that QUS of the heel may be the best indicator of architectural changes within bone which may be influential in predicting ultimate bone density[7].

Cross sectional studies have also been conducted to give more evidence regarding the use of QUS for detecting bone mass. The first study identified the discriminatory ability of QUS to detect related fractures. Five hundred participants were randomly selected to take part in the study. The population was divided into three groups, dependent on their number of prevalent fractures. The results of this study showed that QUS values at the calcaneus showed greater risk of fragility fractures than the DEXA measurements at the same site. If a well-defined clinical threshold existed for QUS, practitioners would be better able to detect patient risk for fragility fractures, which would lead to more acceptance of this method. According to this study, the performance of QUS was comparable with DEXA. These researchers were the first to compare a variety of QUS devices; however, this also was a drawback as the results could not be specifically tied to one manufacture of QUS equipment. Based on the data from this study, continued clinical testing of QUS would be beneficial to establish a clinical benchmark[8].

The second cross sectional study aimed to examine different methods (DEXA, BUA, etc) to assess bone mass across defined female populations, including healthy, premenopausal, and osteoporotic postmenopausal. The sample size for this study was 124 women, with 47 in the healthy category, 41 in premenopausal, and 36 in the postmenopausal. Exclusion criteria for this study consisted of history of bone disease, malignant disease, trauma at measurement sites, and any drug treatment that could influence bone metabolism[9]. All women were examined with each of the modalities, which were computed tomography (CT), DEXA, peripheral quantitative computed tomography (QCT) of the non dominant radius, computed radiographs, and QUS with a variety of devices. The utilization of QUS with the GE/Lunar Achilles equipment was the most relevant to this study. In the study conducted by Grampp et al, QUS techniques showed weak correlations to the other screening techniques. However, because the study populations differed, the results of the different techniques were difficult to correlate. This research found that DEXA displayed smaller age-related changes compared to the other screening techniques for the axial skeleton and peripheral bones except for QUS. Correlations between the different measurement regions of interest (ROIs) using QUS between the various calcaneus sites showed to be weak to moderate when compared with DEXA. However, one of the limitations of this study was the comparison of axial sites with DEXA to peripheral sites completed with QUS. The results showed that all techniques were capable of assessing fragility fracture risk. Since the results were only moderately correlated, it was difficult to make diagnostic classification for women across the techniques[9]

The next level of evidence was a cohort study devised to report the predictive relationship between low peripheral bone mass at different sites and the one year fracture risks at those same anatomical sites. The population for this study was drawn from the National Osteoporosis Risk Assessment (NORA), a longitudinal observational study of postmenopausal women, at risk for osteoporosis, in the United States. Participants had their bone mass measured at peripheral sites, which included the forearm, finger, and heel using QUS. The QUS of the heel generated the least diagnostic measures of osteoporosis. Results were most comparable for DEXA measurements to predict hip fractures with those who had the heel evaluated with single x-ray absorptiometry. Hip fracture occurrence was very low among the QUS patients so the statistical analysis was very much hampered. The conclusion was that all peripheral sites (such as calcaneus or wrist) were similar in predicting fragility fractures after correlation with age. It was also concluded that bone density or other diagnostic tests were just as good at predicting fragility fractures since additional factors influence fracture risk. Peripheral skeletal screening for fracture risk was still recommended as clinicians could secure results at peripheral skeletal sites to adequately predict fractures[4].

The highest level of evidence was a meta-analysis performed on the topic of QUS and the risk of fragility fractures. The purpose of the study was to analyze the association of QUS measurements with fracture risk. The meta-analysis was based on studies from Medline and EMBASE medical literature databases, and 14 additional cohort studies. Low QUS values were found to be associated with a significant increase in subsequent fractures at any site[10].

The low cost and portability of QUS makes it a desirable technology for assessing fragility fracture risk among large populations. Minimizing the exposure to ionizing radiation is believed to increase patient acceptance of screening for low bone mass. Although limited clinical applications have been approved for QUS, the review of published studies supported the value of screening the heel to assess the risk of fragility fractures. As stated in the aforementioned cohort study, the assessment of fracture risk cannot be solely based on bone properties measured by QUS. QUS may also be used as a prescreening tool for identifying subjects a high risk for osteoporosis and then recommending them to further assessment with bone densitometry. The results of this study provided stronger evidence that QUS may be considered an important screening adjunct to DEXA for determining fragility fractures among at risk populations[10].

A gap in the literature exists due to the lack of direct measurements being taken with QUS from Hispanic women. More specifically, data is needed on Hispanic women that are challenged by low socioeconomic living standards and being uninsured for basic health care which may put them at risk for low bone mass and eventual fragility fractures with age. It has been clinically posed that younger women with low bone mass may be at greater risk for fracture during their lifetime with no intervention than older individuals with equally low bone mass because they have a longer anticipated remaining lifespan, and therefore, a longer duration of exposure to the effects of low bone mass[4]. A study is needed to evaluate the feasibility of using QUS to determine the low bone mass of uninsured Hispanic women who have been economical, socially, and culturally been put at risk.

1.3 RESEARCH QUESTION

The objective of the study was to determine the feasibility of conducting QUS screening of uninsured Hispanic women to determine low bone mass in the calcaneus. Since this technique has been reviewed and a guideline has been established for screening the heel and comparing it to DEXA of the spine and hip, it was important to determine if this could have been conducted in a free clinic. The research question that was posed is as follows: **Is QUS a feasible diagnostic technique for determining the bone mass among a sample of uninsured Hispanic women that attend a free clinic?**

CHAPTER 2

METHODOLOGY

This research is a descriptive study of uninsured Hispanic women and as such, represents a case study of their QUS results. The threats to internal and external validity do not allow for these results to be generalized beyond this group of Hispanic women.

2.1 POPULATION AND SAMPLE

Participants were a convenience sample of uninsured Hispanic women who consented to participate in the QUS screening procedure during their physician's visit at le Clinica Latina at the Thomas E. Rardin Family Practice Center. Volunteer services at le Clinica Latina were offered twice a month to Hispanics from central Ohio. *Sampling strategy*: This involved a convenience-sampling approach for those Hispanic women that attended the Clinica Latina that is held twice a month. Potential participants were approached by the student interpreter. All women who were over the age of 18 were asked to participate in the study.

The participants placed their heel in the GE Achilles Bone Ultrasonometer which allowed transducers on either side of the heel to send sound waves through it, measuring speed and attenuation. Speed of sound (SOS) and attenuation were not used independently for this study because they are temperature dependent measurements. By adding them together, they become less dependent on temperature, allowing for a stronger measurement. The combination of SOS and attenuation is the quantitative measurement of stiffness index (SI). GE has provided a chart for interpretation of all bone stiffness scores and their age matched plots. See Figure 2, Table 1.

Those participants who, after age-matching their SI scores with the z-scores on GE's graph that was constructed from their own sample, fell on the curve and had a score that was indeterminate, their results were reviewed by Dr. Ashcraft, Medical Director of Clinica Latina and possibly referred to DEXA for absolute confirmation.

The justification for the sample size was based on the few studies that have been conducted using ultrasound to evaluate bone density. Most of the cited studies utilized women who were postmenopausal and native to the study's staging region. Four studies were reviewed that are similar in scope to the proposed project; two of studies were multiyear projects and the recruitment was as follows:

	N	US/BD	# sites	Length of study	N/site/year
Benitez, et. al 2000	206	1 year	1	1 year	206
Kung, et. al. 1999	1086	1 year	3	1 year	362
Kung, et. al. 2003	722	3 years	1	3 years	240
Agostinelli, et. al. 2007	268	5 years	1	5 years	53

It seemed appropriate for this research to last one year at the free Hispanic clinic and recruit 70-100 patients during that time. This was very comparable to the studies cited in the table provided. The power analysis, a priori, provided by biostatistics allowed for a statistical power level of 0.77 (77%) with a moderate effect size and an alpha of .05, based on 70 patients. It is important to determine the power analysis and sample size because it allows researchers to decide how large a sample is needed to produce accurate and reliable results and how likely the statistical test will be able to detect effects of a given size in a particular situation.

This is an OSU IRB approved project that is being supervised by Dr. Kevin Evans and the OSU IRB approval is 2007H0222. The project is nested in the overall research being conducted titled: Investigating bone density and calcium consumption among uninsured Hispanic women. Dr. Evans is the Principal Investigator and Dr. Taylor is serving as the co-PI on the project. The responsibilities of the student researcher were to consent patients and provide QUS measurements at le Clinic Latina.

2.2 DESIGN

This is a feasibility data collection and is considered a pre-experimental research design or case study. The data was collected and completed by the end of the summer of 2008.

2.3 DATA AND INSTRUMENTATION

The data has been expressed with means and compared to age matches that were provided by the regression curve given by the machine computer to determine which patients have low bone mass for their age match.   This is a descriptive study of the feasibility of this screening technique and its utilization with this segment of women in a free clinic. The anticipated statistics were to provide frequencies and means for the bone density that is recorded from the sample of Hispanic women.

Measurement of bone fragility

The Achilles InSight Bone Ultrasonometer is an economical, reliable alternative to DEXA for fracture risk assessment. The machine transmits over 95 mm of distance with a 588 element solid-state matrix array. The transducer incorporated into the machine has a central frequency of 55 KHz and targets its ultrasound beam through a water bath heated to 33-35 degrees C, or 92 degrees F. Before obtaining measurements on the patients each day, the machine was calibrated with General Electric's Plexiglas phantom to ensure that quality control was acceptable.

The set-up involved preparing each participant for this test by spraying their heel with rubbing alcohol to act as an acoustic coupling agent to maintain the precision of the measurement.   The manufacturer records a precision of 1.95% for bone stiffness index. The equation for calculating the SI is as follows[11]:

Stiffness Index = (0.67 x BUA) + (0.28 x SOS) – 420

For each patient, a series of two to three measurements were taken to ensure reproducibility. The average of the measurements was then used for estimation of BMDz and Stiffness Index. Each individual calcaneus measurement took approximately 15 seconds, which is the standard for measurements obtained using the alcohol coupling agents.

2.4 STATISTICAL ANALYSIS

Frequency and descriptive statistics were used to illustrate the measures of bone fragility in Hispanic women. The survey data was normally distributed so means could be compared with the values obtained for SI. A Pearson Product moment was used to determine the correlation between the stiffness index and the bone density-z score.

CHAPTER 3

RESULTS

A convenience sample of uninsured Hispanic women that attended the free clinic from December 1, 2007 to June 30, 2008 was recruited; however, only 69 out of 70 were able to complete the entire research process. One participant was only able to have one measurement done, so it was deemed a not accurate measurement and thrown out. The median age of the participants was 33 years (mean 32.7, SD 11.0) with a range of 18-74 years. The mean calcaneal SI and BMDz was 99.3 (SD 14.2) and 0.11 (SD 0.87), respectively (Table 2). There was a strong, direct relationship between BMDz and SI values ($R=0.92$, $p < 0.05$). The mode of age of participants was 26 years, with that age appearing six times.

DISCUSSION

A variety of factors need to be considered when interpreting the data from this sample of uninsured Hispanic women who attended a free clinic. The stiffness index that was measured with QUS was introduced to improve the standardized coefficient of variation between measures, such as SOS and BUA. The SI was proposed as a reliable measure of bone mass because it was relatively unaffected by temperature changes in the heel[12].

This study found a statistically strong correlation ($R = 0.92$, $p < 0.05$) between the z-scores and SI for these patients, which made for a strong dependent variable to determine bone mass in the calcaneus. A z-score represents the percent of scores that age match on the graph. A scatter plot illustrates this pronounced relationship of the z-scores of GE's sample of women used to construct their graph and the stiffness indices for this group of Hispanic women (Figure 3). A graph is also provided by the manufacturer to interpret the z-scores of GE's sample and SI values of this sample that were collected using QUS (Figure 2). The mean z-score of 0.11 was well above the guideline of low bone mass, which was represented with a z-score of -1.5. The mean stiffness index of 99.3 indicated that on average, the participants in this study had adequate bone mass. A study conducted by Hadji et al[13] found that a healthy premenopausal woman has a mean SI of 89.9, which relates well to the study sample which was composed predominately of younger women.

While the reliability of the SI measurement was an important aspect of evaluating QUS as a feasible means for determining the bone mass of impoverished Hispanic women, there were other factors that needed to be evaluated, such as economic cost and portability. Cost was especially important since the sample measured in this study were impoverished women. Currently, a dual energy x-ray absorptiometry (DEXA) scan to screen for low bone mass can cost as much as $295. Since QUS is a newer technology, there are not yet any reported costs for a single screening. Many health insurance companies do not pay for screenings, but may pay for DEXA screening if the patient shows the signs, symptoms, and/or risk factors for osteoporosis[14]. In comparison, an ultrasound of the heel is a relatively inexpensive test that generates an outcome similar to a DEXA. Screening the heel with ultrasound, which allows for patients to be sorted into risk categories and only those at greatest risk are referred for a more expensive DEXA scan. Using QUS as a screening measure is more beneficial for the study sample of Hispanic women due to their impoverished circumstances and lack of insurance. This diagnostic technique could have significant impact for these women with limited resources.

Portability is another aspect of using QUS that is extremely attractive to underprivileged Hispanic women. The women that attended the free clinic did so because it was a walk-in facility; patients were not required to set up appointments and then follow through with the visit. This allowed the women to come when it was most convenient for them. DEXA scans require patients to set up appointments at a nearby radiology practice because this type of test is in no way portable. The Achilles Heel Ultrasonometer is a portable mechanism which allows practitioners to transport it where there is a high volume of need. Instead of having patients make appointments and then travel to a facility, practitioners go to the patients. An ultrasound of the heel is also a quick exam, with each scan taking approximately 15-30 seconds. Patients can get their screening while waiting to see the physician at free clinics.

This research represents the early development of a more diverse model of prediction in an underserved population that includes perimenopausal Hispanic women. QUS has been used previously in research studies with older women but infrequently with perimenopausal women and even more seldom with women who are non-Caucasian. This study illustrates the feasibility to conduct a rigorous study using QUS and taking reliable measurements of SI and BMDz.

There were some limitations in that the design does not allow for generalization to a larger group of uninsured Hispanic women. It is also limited by the lower amount of participants; therefore, a larger study is advocated with an increased number of critical risk factors (CRF), such as diet, physical activity, and hormone status, that would possibly allow for better indicators of low bone mass among Hispanic women of poor socioeconomic status.

A different limitation was the amount of women who were categorized in the indeterminate diagnostic range of bone density. To be indeterminate, the participant had to have an SI that was plotted on the curve of GE's graph and fall in the B range (Figure 2). Out of 69 study participants, 6 women had QUS results that were classified as being in the indeterminate range (Table 1, 2). What this means is that when their SI results were plotted on the GE graph, their z-scores did not match with the sample provided by GE. The results of the heel ultrasound were inconclusive, and after the participant consults with her physician, may also require a DEXA scan to examine the spine and femur to rule out osteoporosis (Table 1, Figure 2). A correlation with the actual DEXA measurements of these 6 women would have been very helpful to determine the sensitivity of the screening made by QUS. Unfortunately, these 6 women to date have not had the resources to follow up with a DEXA as recommended by Dr. Ashcraft.

While there are still gaps in the research, this study design is a start to forging the way for osteoporosis screenings for uninsured Hispanic women. With continuing research and advancement, it will be determined that QUS screenings of the calcaneus are acceptable and feasible means to ascertain the bone mass of uninsured Hispanic women.

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Figure 1. Achieving Peak Bone Mass throughout the Life Cycle.

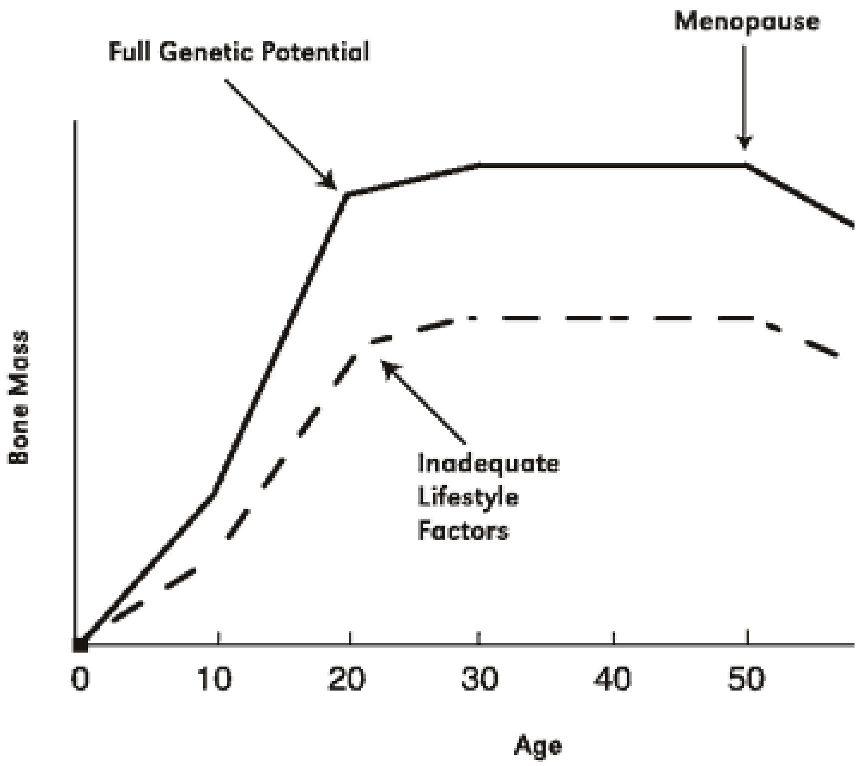

Figure 2. GE Achilles Stiffness Index Graph for Determining Low Bone Mass

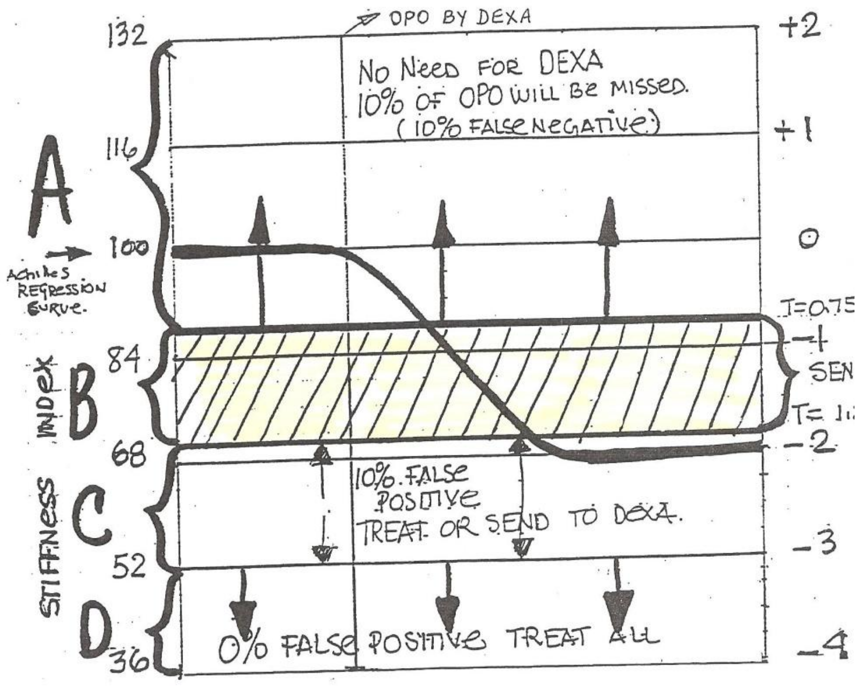

Figure 3. Correlation of Mean Stiffness Index with Mean Z-scores of Impoversihed Hispanic Women.

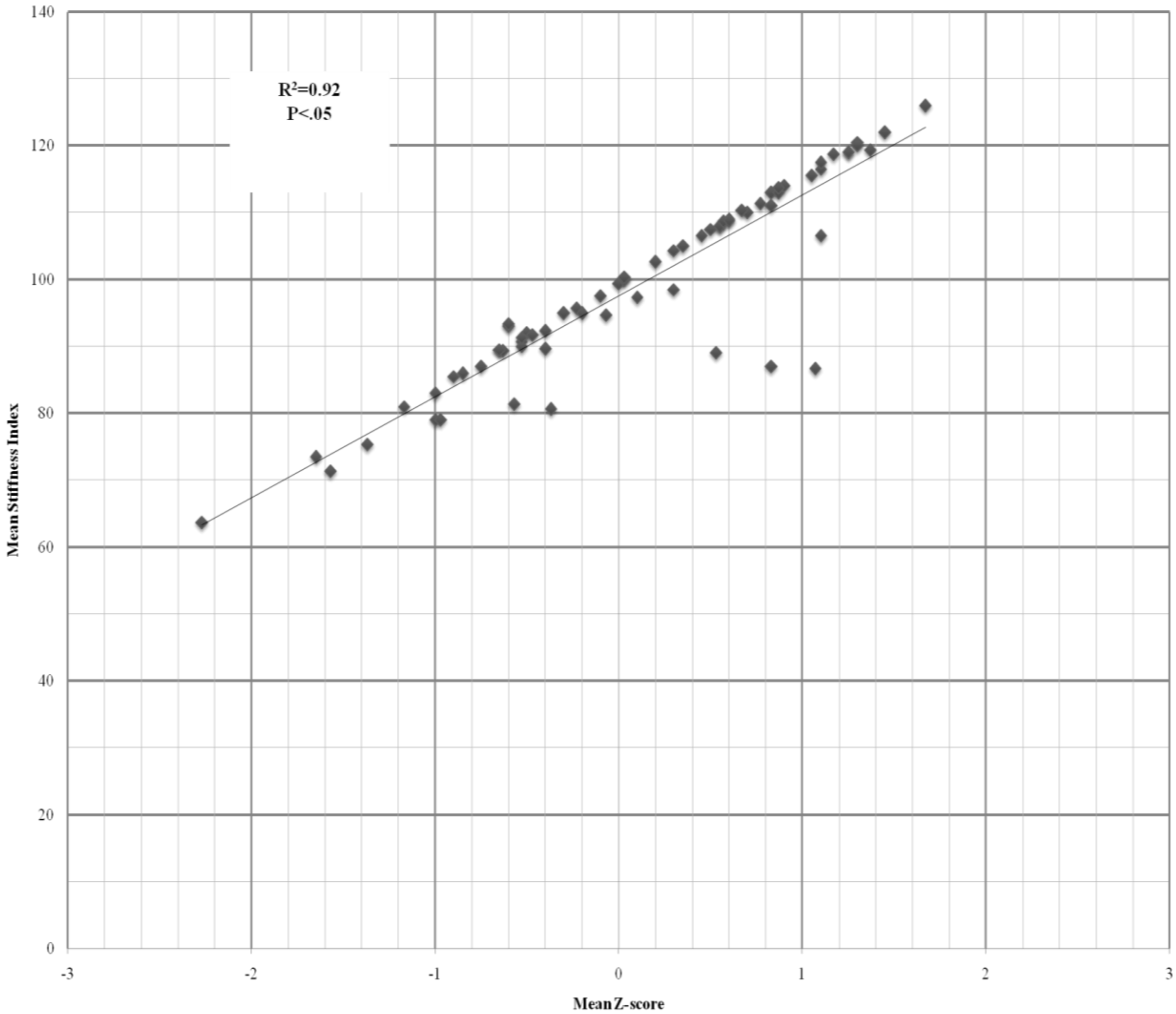

Table 1. Interpretation of GE/Lunar Achilles bone stiffness scores vs. age matched plot.

A - Your heel ultrasound results demonstrate a 90% probability that you do not have osteoporosis. The ultrasound measurement of your heel (os calcis) is within normal range.

B - Your heel ultrasound results are within a diagnostic range that make it difficult to rule out osteoporosis. In consultation with your physician, it is suggested that you seek further evaluation by scheduling a bone density test of your spine and femur.

C - Your heel ultrasound results demonstrate a 90% probability that you may have osteoporosis. In consultation with your physician, it is suggested that you seek further evaluation by scheduling a bone density test of your spine and femur. There is a 10% probability that you do not have osteoporosis.

D - Your heel ultrasound results demonstrate a 99% probability that you may have osteoporosis of the spine and/or femur. In consultation with your physician, it is strongly suggested that you undergo both a bone density test and initiate treatment to correct this condition.

**refer to Figure 2 as a reference for the use of scoring A-D.*

Table 2. Interpretation of Data.

Patient ID	Patient Age	Number of Measurements	Average Stiffness Index (SI)	Average Z Score for SI
1	51	3	81.33	-0.57
2	74	3	86.67	1.07
3	18	3	112.67	N/A
4	39	4	108.75	0.60
5	48	2	98.50	0.30
6	26	3	89.33	-0.63
7	22	3	113.0	0.83
8	29	3	113.0	0.87
9	20	3	113.67	0.87
10	33	2	97.50	-0.10
11	27	3	100.33	0.03
12	28	3	117.0	1.10
13	29	3	108.67	0.57
14	26	2	95.0	-0.30
15	32	2	114.0	0.90
16	21	2	85.5	-0.90
17	22	2	108.0	0.55
18	26	2	117.5	1.10
19	36	2	106.50	0.45
20	39	3	95.00	-0.20
21	34	2	120.0	1.30
22	20	2	86.0	-0.85
23	24	2	89.50	-0.65
24	27	2	110.0	0.70
25	28	2	108.0	0.55
26	27	3	111.33	0.77
27	32	2	89.50	-0.65
28	24	3	93.33	-0.60
29	24	3	92.0	-0.50
30	48	3	94.67	-0.07
31	28	2	105.0	0.35
32	32	2	109.0	0.60
33	31	2	120.5	1.30
34	23	2	122.0	1.45
35	28	2	107.50	0.50
36	26	2	119.0	1.25
37	33	3	100.0	0.03
38	47	3	79.00	-0.97
39	38	2	115.5	1.05
40	44	3	75.33	-1.37

41	35	3	90.67	-0.53
42	43	3	119.33	1.37
43	58	3	89.0	0.53
44	22	3	81.0	-1.17
45	25	3	102.67	0.2
46	30	3	99.33	0
47	45	3	71.33	-1.57
48	65	3	87.00	0.83
49	43	3	97.33	0.10
50	20	3	95.67	-0.23
51	19	3	110.33	0.67
52	26	3	92.33	-0.40
53	31	3	83.00	-1.0
54	54	3	80.67	-0.37
55	27	3	126.0	1.67
56	25	3	104.33	0.30
57	40	3	90.0	-0.53
58	21	3	118.67	1.17
59	45	3	89.67	-0.40
60	31	3	63.67	-2.27
61	24	3	91.33	-0.53
62	47	3	79.00	-1.0
63	34	2	116.5	1.10
64	26	3	93.0	-0.6
65	20	3	100.33	0.03
66	42	3	111.0	0.83
67	36	2	119.0	1.25
68	32	3	91.67	-0.47
69	36	2	87.0	-0.75
70	23	2	73.5	-1.65

Mean Age	32.7 years, SD 11
Median Age	33 years
Mean SI	99.3, SD 14.2
Mean BMDz (z-score)	0.11, SD 0.87